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*Full Length Research Paper*

# Fruit flies (Diptera: Tephritidae) populations Dynamic in mangoes production zone of Côte-d'Ivoire

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**Abstract**

**The mango is the most universally produced fruit. In Côte-d'Ivoire, the mango official channel is threatened by fruit flies. The objective was to study the fluctuation of fruit flies population in the mango production zone in Côte-d'Ivoire. From June 2005 to September 2006 and September 2008 to August 2009, the traps using sexual attractants and an insecticide block were placed in mango orchards to capture the flies' males. In addition, various mangos ripe and those attacked by the fruit flies were collected in localities and incubated in vats in laboratory. The population fluctuation of flies' was determined through a weekly measurement of the trapped flies. Thirteen species were identifies. The fly *Bactrocera invadens* had the largest population across the studies zones: 97.92% in central and 86.53% in north. It was present throughout the year during mangoes seasonfrom March until August. The species*Ceratitiscosyra*abounds during the maturation of the early varieties as from February until July. *C. bremii*appeared from April to July. The flies abound from March in Central and Northern of Côte-d'Ivoire. Thus, an advanced knowledge of the fluctuation of flies' populations proves to be necessary for a durable and effective control of these pests.**

**Keywords:** mango, fruit flies, invasive species, fluctuation

## INTRODUCTION

The tropical and subtropical fruits get significant currencies with the producers, in Africa and particularly in Côte-d'Ivoire. The fruit-bearing sector is under the management of the small farmers (Vayssières*et al*., 2005) and doesn't remain very productive. However, more than 98% of the world production of tropical fruits has come from the developing countries, during these ten last years (FAO, 2001). Thus, the mango with 36 % of the world production of the tropical fruits, represents the more universally produced fruit (FAO, 2001). In Africa and particularly in Côte-d'Ivoire, the sector is the permanent under threat of fruits flies of Tephritidae family (N'guetta et Hala, 1999; N'Da*et al*., 2001; Vayssières*et al*., 2004; Hala*et al.*, 2006; N'dépo*et al*., 2009). This family is represented in all regions of the world except the Antarctic region. She includes more than 4000 species grouped into 500 genres. Approximately 35 % of the species are confined to fruit and 250 species are economically harmful. These flies attack more than 50 fruit trees including citrus and berries (mangoes) (White et Elson -Harris, 1992; Vasquez *et al*, 2002; Sávio*et al*., 2008). In Afrotropical region, 140 genera including 65*Ceratitis* spp*, 14 Bactrocera*spp and 170 *Dacus*spp are known. They are frightening pests of fruit and vegetables

in the world (White et Elson-Harris, 1992). They are responsible for significant damage in mango orchards (Sávio*et al*., 2008). The female flies prick and lay eggs under the skin of the fruits. The eggs hatch and release the larvae which present three immature stages before reaching adult stages. The first two larval stages occur in plant tissues and cause the fall of the fruits. In the third stage, the larvae eject out of the fruit, to ensure they pupate in the soil from which the adult emerges and the cycle begins again (White et Elson-Harris, 1992). For example, in Mali, the losses due to the fruits flies on a national production of mangos were estimated to 50% (Vayssières*et al*., 2004). Likewise in Benin, these losses vary between 10 to 60% in mango orchards (Vayssières*et al*., 2005). In Côte-d'Ivoire, the mango carries a significant load of infestation and was strongly attacked by *Bactrocerainvadens* Drew, Tsuruta& White. (N'dépo*et al*. 2009, 2010). Thus, the losses fluctuate between 17% at the beginning of mangos season and 80 % at the end of the mangos season, and even more (N'dépo, 2010). In those mangos production areas, the species met primarily are from genera *Ceratitis* and *Bactracera*. Also, in the North of Queensland, in 1990, the incursion of *B. papayae* Drew & Hancock caused losses reaching 100 million Australian dollars. Similarly, the damages caused by *Ceratitiscapitata*Wiedemann in California and in the South of the United States were evaluated to more than one billion American dollar (Jacques et Ivan, 2010). Indeed, these pests pullulate in the orchards with the close relation of the fruits maturity. The objective was to study the dynamics of fruit flies' populations in mangos production zone in Central and Northern Côte-d'Ivoire.

## Material and methods

### Site of study

This study proceeded in two periods. Initially from June 2005 to September 2006 in Yamoussoukro in station experiment. And in the second time, from September 2008 to August 2009, in the principal producing zones of mangos in Central and Northern Côte-d'Ivoire. In Central Côte-d'Ivoire (climate of transition) , the experiments were set up in two localities: Yamoussoukro (06°53' N and 05°06' W; average temperature 27.2°C and 1200 mm of rains fall) and Katiola (08°01' N and 05°06' W; average temperature of 27.2°C and 1200 mm of rains fall) in farmer's orchards. This zone benefits from two or four seasons according to the year with variations of temperature significant. It is characterized by the absence of correlation between the wet seasons and of presence of a dry and hot wind from December to February. Like crop plants, one meets there the mango tree, cacao-tree, coffee-tree, cashew tree and some citrus fruits (orange, tangerine, grapefruit). In the North area, Korhogo and Sinématiali were selected. In Korhogo one on-station experiment (09°34' N and 05°37' W; average temperature of 25.5°C and 1100 mm of rains fall) and one experiment in farmer's orchards (09°35' N and 05°41' W; average temperature of 25.5°C and 1100 mm of rains). In Sinématiali the experiment was conducted in the farming environment (9°33' N; 05°24' W; average temperature of 25.5°C and 1 100 mm of rains fall), "pilot orchards" where were selected to shelter the tests of « *regional project on the control of the fruit flies in West Africa* ». This zone is characterized by two seasons: a dry season and a wet season with weak rainfall. One also notes the presence of a dry and hot wind from December to January, with a weak of the relative humidity. One meets there of many shea trees, the forest small islands and the fruit-bearing cultures (mangos, cashew nuts, papaws, citrus fruits…)

### Trapping with sexual attractants

Four dry traps (Tephri-Trap, McPhail-Trap) with sexual attractants (METHYL eugenol, CUE lure, DORSALURE and CAPILURE) from 2005 to 2006 and 36 others traps with attractants (methyl eugenol, terpinyl acetate, trimedlure) and insecticide (Dichlorvos) from 2008 to 2009, were hung in the orchards using a wire. They were suspended with a height of 1.60 to 1.80 m approximately above ground (Ouattara, 1998). The branch support was covered with a solid layer of grease to avoid the predatory activity of the ants on the captured flies. The traps were laid out according to an optimal distance from 40 to 50 m between two consecutive traps to avoid the interferences between them (Vayssières*et al.,* 2008). The content was raised each week and the flies were preserved in alcohol 70% before identification in the laboratory. The sexual attractants and insecticide were renewed each month. In total, forty traps including four (1 trap per pheromone) initially and 36 others (2 to 4 traps per bait according to the orchard surface) in second time, were used because of 4 traps per hectare. The traps were distributed as follows: 6 traps in Yamoussoukro, 12 in Katiola, 6 in Sinématiali and 12 in Korhogowith 6 in the station experiment and 6 in the farming environment. For the trapping, we used a completely random device. The abundance of the monthly captures was taken into account for the follow-up of the populations dynamic.

### Collect, incubation of mangos and rearing of fruit flies

Various mangos varieties (*Kent, Keitt, Amelie*) close to maturity or in maturity, picked and these fallen on the ground, were collected and counted. These fruits were weighed and incubated at the laboratory by batches of five and were placed in vats (containers) containing sand

**Table 1**.Average capture weekly of fruit flies according to localities. The flies were captured by lures in traps in the mango orchards

| Species | Yamoussoukro | Katiola | Korhogo | Sinématiali |
|---|---|---|---|---|
| *B. invadens* | 293.78 ± 47.15b | 19.55 ±4.61b | 358.3 ± 68.7b | 153.61± 44,95b |
| *B. cucurbitae* | - | - | 0.01 ± 0.01a | - |
| *C. cosyra* | 2.04 ± 0.7a | 0.41 ± 0.15a | 48.17 ± 9.21ab | 39.63 ± 9.69a |
| *C. capitata* | 0.28 ±0.19a | - | 0.38 ± 0.09a | 0,15 ± 0,05a |
| *C. anonae* | 1.55 ± 1.25a | - | 2.49 ± 0.74a | 0.54 ± 0.34a |
| *C. punctata* | 0.02 ± 0.19a | - | 0.18 ± 0.11a | 0.04 ± 0.02a |
| *C. bremii* | 0.64 ± 0.16a | 0.2 ± 0.07a | 2.34 ± 0.67a | 3.63 ± 1.57a |
| *C. rosa* | 0.06 ± 0.03a | - | 0,37 ± 0,09a | 0.24 ± 0.09a |
| *C. ditissima* | - | - | 0.01 ± 0.01a | - |
| *C. fasciventris* | 0.05 ± 0.05a | - | - | - |
| *C. pedestris* | 0.02 ± 0.02a | - | - | - |
| *D. bivittatus* | 4.36 ± 1.91a | - | - | - |
| *D. langi* | 0.36 ± 0.28a | - | - | - |
| *D. mediovittatus* | 0.05 ± 0,05a | - | - | - |
| *D. punctatifrons* | 2.5 ± 1.76a | 0.01 ± 0.01a | 0.02 ± 0.01a | - |
| *T. coffeae* | 0.21 ± 0.09a | - | 0.01 ± 0.0a | 0.01 ± 0.01a |
| Probability | P=0.000 | P=0.000 | P=0.000 | P=0.000 |

- : Absence of the species
Means followed different letters in the same column are significantly different according to Newman-Keuls at P < 5 %.

anteriorly humidified, the vats were covered separately with a fabric mosquito net. When rotting, the fruits were dissected to recover the larvae by floating and sieving. The sand of the vats was washed to unearth and recover by sifting the larvae and the pupae already hidden. Those were counted, then placed in boxes of the 3rd lifting out of plastic at a temperature of 27.5°C approximately and 88% of relative humidity until the emergence of the adult flies which were counted at once.

### Identification of Tephritidae species

The fruit flies collected were identified in the laboratory with a magnifying glass and the guides of fruit flies identification (De Meyer, 1996, 1998, 2000; Ekesi et Ballah, 2007) through the morphological features and the pictures of recognition of the flies. The species not clearly identified were sent to the Royal Museum of Central Africa (MRAC), in Belgium, for confirmation.

### Statistical exploitation of the data

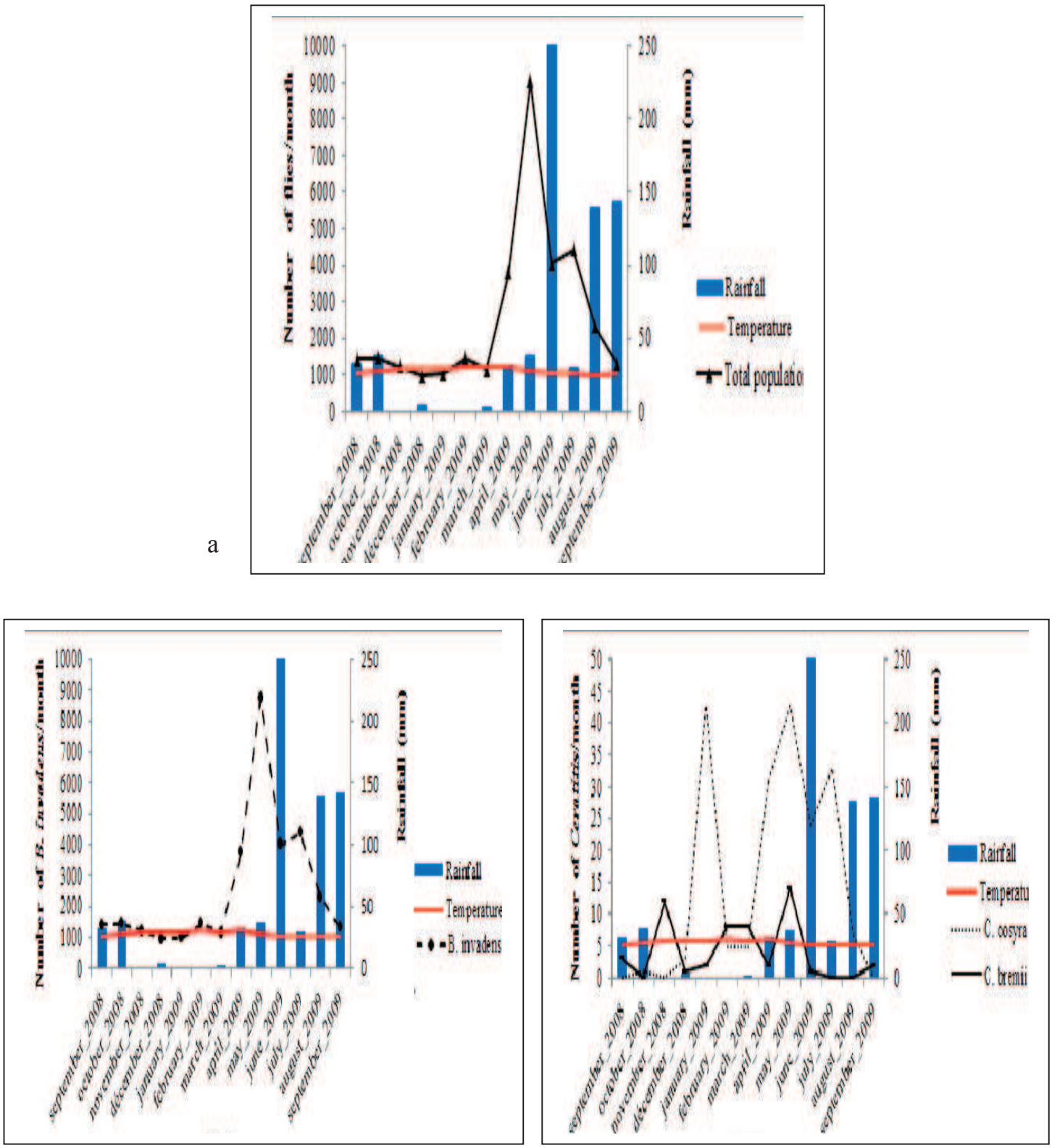
The data collected were analyzed with a statistical software; STATISTICA v7.1. Analysis of variance (ANOVA) was carried out on the weekly capture of the species of flies per locality. The statistical significance was considered was fixed a α = 5 %. Multiple means separation was done according to the test of Student Newman-Keuls.

## RESULTS

### Specific composition of fruits flies according to location

### Yamoussoukro

Fourteen species of fruit flies were identified in the locality of Yamoussoukro *B. invadens*Drew, Tsuruta et white, *Ceratitiscosyra* Walker, *Ceratitiscapitata*Wiedemann, *Ceratitisanonae* Graham, *Ceratitispunctata*Wiedemann, *Ceratitisbremii* Guerin-Meneville, *Ceratitisrosa*Karsch, *Ceratitispedestris*Bezzi, *Ceratitisfasciventris* De Meyer , *Dacusbivittatus* Bigot, *Dacuspunctatifrons* Bigot, *Dacuslangi* Curran, *Dacusmediovittatus* Whiteand *Trirhithrumcoffeae*Bezzi. Among them last, the invasive species *B invadens* was captured at rate of 293.78 ± 47.15 flies/week. This was followed by the native species *C. cosyra* and *C. anonae*with 2.04 ± 0.7, and 1.55 ± 1.25 flies/week,respectively. The other species were fairly represented and the abundance of capture ranged from 0.02 to 0.64 ± 0.16 flies/week. The statistical processing showed a highly significant difference (P < 0.01) between abundance of flies' species (Table 1).




a

b

c

**Figure 1:** Variation of the abundance of fruits flies populations in Yamoussoukro
**a:** total population; **b:** population of Bactrocerainvadens; **c:** populations of Ceratitiscosyra and Ceratitisbremii

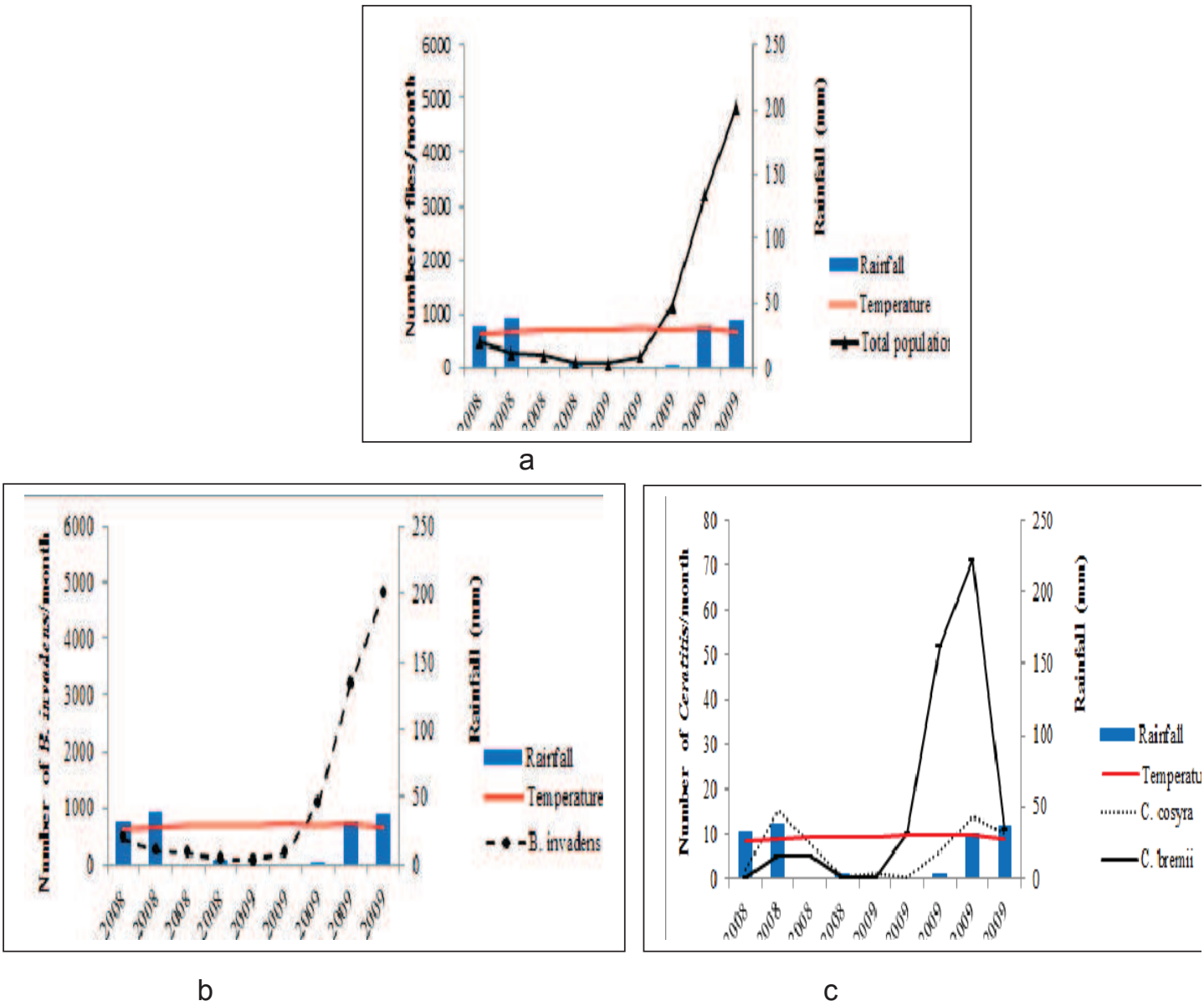


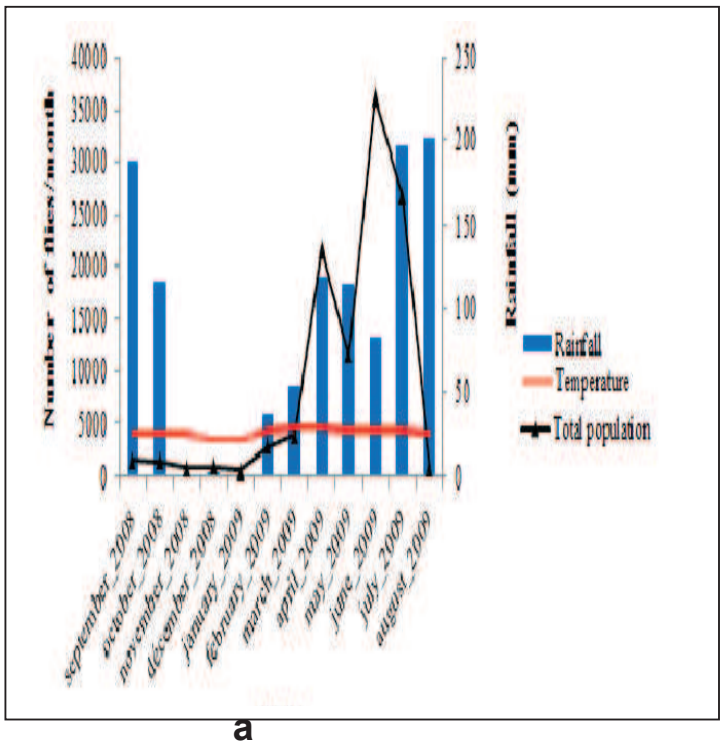

**Figure 2:** Variation of the abundance of fruit flies populations in Katiola
**a:** total population; **b:** population of Bactrocerainvadens; **c:** populations of Ceratitiscosyra and Ceratitisbremii

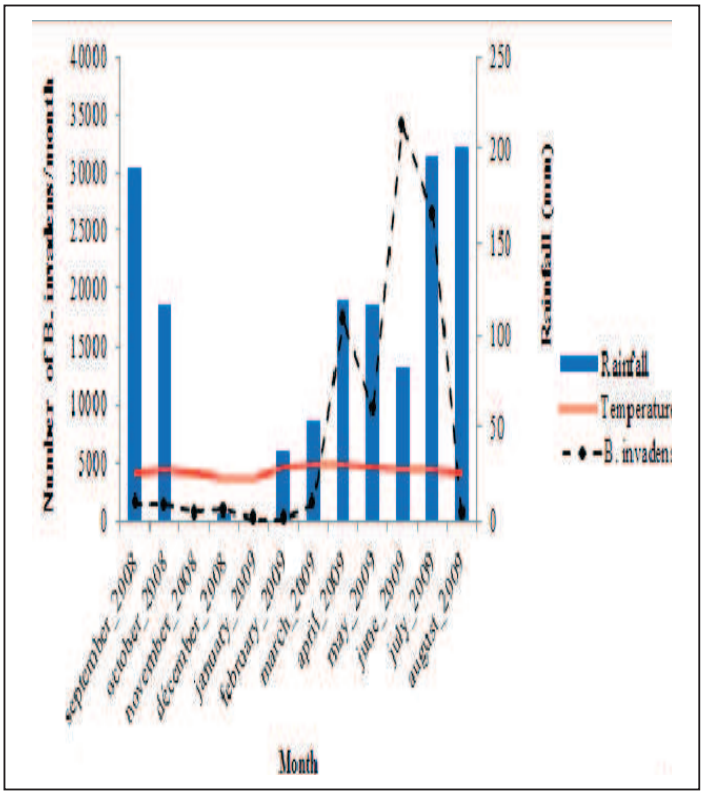
## Katiola

Four species of fruit flies were identified. *B. invadens* was the dominant species. It was captured at a rate of 19.55 ± 4.61 flies/week. The minor species *C. cosyra, C. bremii* and *D.punctatifrons*were captured at rate varying between 0.01 ± 0.01 and 0.41 ± 0.15 flies/week. The statistical showed a highly significant difference (P < 0.01) between the abundance of the various species (Table 1).

## Korhogo

Eleven species of fruit flies were identified including one significant population of the invasive fly *B. invadens*. It was captured at a frequency of 358.3 ± 68.7 flies/week. The populations of C. *cosyra, C. anonae* and *C. bremii*were not very abundant with a mean capture of 48.17 ± 9.21 flies/week, 2.49 ± 0.74 flies/week and 2.34 ± 0.67 flies/week, respectively. The other species (*C.*



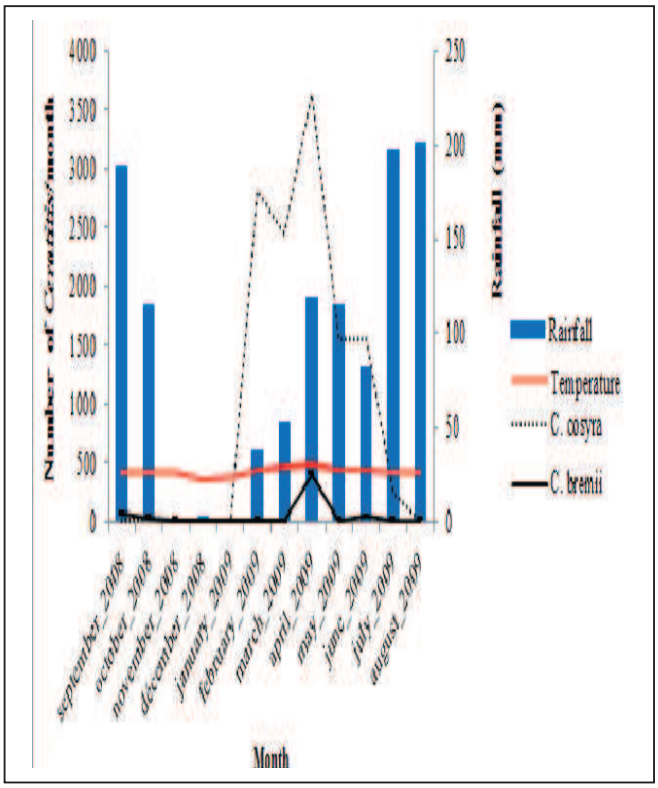




**Figure 3:** Variation of the abundance of fruit flies populations in Korhogo

**a:** total population; **b:** population of Bactrocerainvadens; **C:** populations of Ceratitiscosyra and Ceratitisbremii

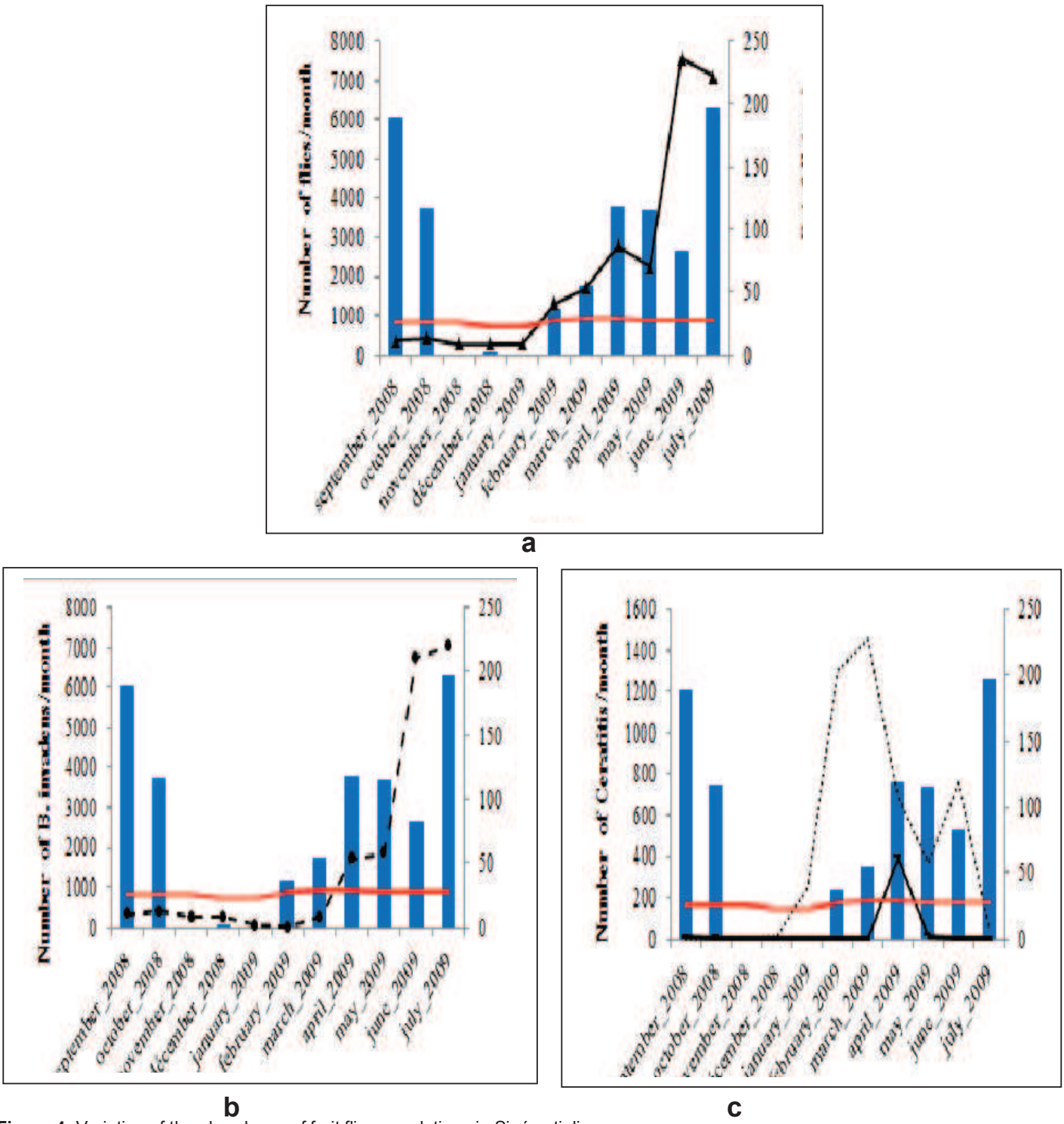



**Figure 4:** Variation of the abundance of fruit flies populations in Sinématiali
**a:** total population; **b:** population of Bactrocerainvadens; **c:** populations of Ceratitiscosyra and Ceratitisbremii

*anonae, C. capitata, C. ditissima, C. punctata, C. rosa, D. punctatifrons, B. cucurbitae*and *T. coffeae)* were fairly represented, mean captures ranging from 0.01 to 0.38 ± 0.09 flies/week. The statistical analysis showed a highly significant difference (P < 0.01) between the abundance of the various species (Table 1).

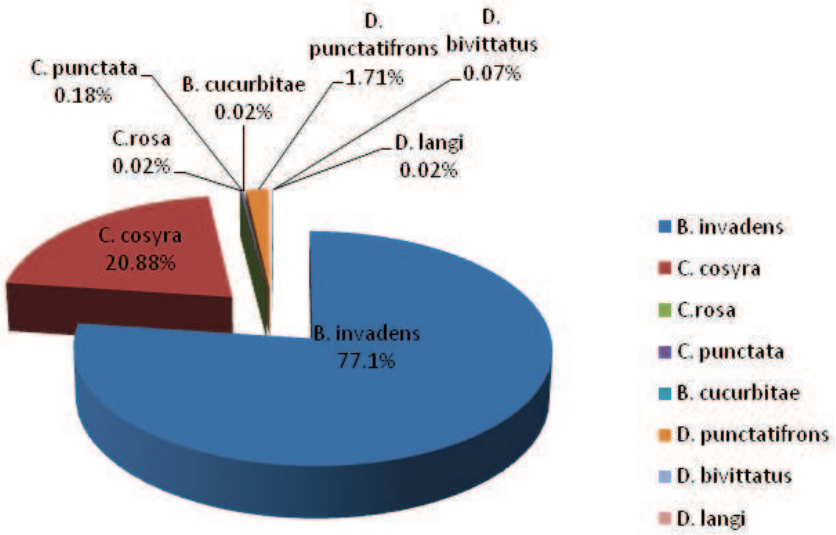



**Figure 5:** Emerged Tephritidea species from mango and their rate presence

**Sinématiali**

The trapping method set up in this location allowed identifying eight species of fruit flies. Among them, the invasive fly *B. invadens*, the native flies' *C cosyra*and *C bremii*were represented. They were captured at rate of 153.61 ± 44.95, 39.63 ± 9.69 and 3.63 ± 1.57 flies/week,respectively. Other species of fruits flies (*C. capitata, C. punctata, C. rosa, C. anonae* and *T. coffeae)* were minor. They present a mean captures ranging between 0.01 and 0.54 ± 0.34 flies/week. The statistical analysis showed a highly significant difference ($P < 0.01$) between abundance of the flies (Table 1).

**Variation of fruit flies' populations according to locality**

This study is devoted to the most abundant populations of the period from September 2008 to August 2009, in the zones of Yamoussoukro, Katiola, Korhogo and Sinématiali (The data of trapping were collected in station and in farming environment). The monthly abundance of the species of *C. cosyra, B. invadens* and C. *bremii*was considered for better determination the periods of pullulation of the flies. The abiotic factors were provided by weather stations

**Yamoussoukro**

**Total population**

Although the population of fruit flies presented throughout the year, it decreased drastically during the dry season (November to March). At the beginning of the rainy season (April), the population grew and the fruit flies pullulate during all this season and reached a peak of abundance in May 2009 (9 020 individuals) .Afterward, the population dropped until the next dry season (Figure 1a).

**Principal species**

The population of *B. invadens* presents a fluctuation similar to that of the total population of fruit flies. It presents a weak level of population in dry season (November to March) (Figure 1b). In rainy season (April to October) and in mango season (mid-March at July), the invasive flies pullulated and the population was growing until reaching a peak of abundance in May 2009 (8 743 individuals). This population dropped until the next dry season. As for the species *C. cosyra* and *C. bremii*, the populations move almost in teeth of saws throughout the year. The population of *C. cosyra* grew in dry season and reached the peak of abundance in January 2009 (43 individuals), during the rainy season the population of *C. cosyra* achieved the maximum population in May 2009 and July 2009 with 43 and 33 individuals, respectively (Figure 1c). The population of *C. bremii*showed a fluctuation similar to that of the population of *C. cosyra*. However, the peaks of abundance observed in November 2009 (12 individuals) and in May 2009 (14 individuals), were very low compared to those of *C. cosyra*(Figure 1c).

**Katiola**

**Total population**

The fruit flies were present throughout the year. However the flies' population fluctuated and was influenced by the

different seasons. The flies' population was relatively low (80 flies) in dry season (November at March). From the mango and rainy season, the population become significant and grew to reach an abundance of 4 832 flies in May 2009 (Figure 2a). Unfortunately, the trapping of the flies was stopped for technical reasons in that locality.

### Main species

The population of *B. invadens* showed a fluctuation similar to that of the total population. In dry season, it dropped considerably until reaching 79 flies in January 2009.In the beginning of rainy season (April), *B. invadens* population grew to reach a populations of 4 807 flies in May 2009 (Figure 2b). The population of *C. cosyra* was relatively high in rainy season. It presented 2 peaks of abundance; one in October 2008 (15 flies) and another one in April 2009 (14 flies). In dry season, the population decreased considerably (Figure 2c). As for the population of *C. bremii*, it is relatively weak from September 2008 to February 2009 (10 flies). From March 2009, the flies' population was increasing and reached a peak in April 2009 with 71 flies. The population dropped gradually until May 2009 (Figure 2c).

## Korhogo

### Total population

The fruit flies had as a whole a low level of population in dry season (November at January). The flies' population increased from the beginning of the rainy season (February) and showed two peaks of abundance in April 2009 (21 685 flies) and in June 2009 (36 322 flies) (Figure 3a).

### Main species

The population of the invasive fly *B. invadens* varied throughout the year and fluctuated similarly to the total population of fruits flies. The population was low in the dry season (November at January) and at the beginning of the rainy season (February). From March 2009, the population rapidly increased to reach a peak in April 2009 (17 389 flies) and another one in June 2009 (34 253 flies) before decreasing gradually (Figure 3b). The population of the native *C. cosyra* was almost low from September 2008 to January 2009. Its population decreased from 14 individuals in September 2008 to 4 individuals in January. From February 2009, *C. cosyra* reappeared with two peaks of growth in February 2009 (2 808 flies) and in April 2009 (3 642 flies) (Figure 3c). As for *C. bremii*, it appears in March 2009 and grows until reaching a peak of growth in April 2009 (406 flies), then drops (Figure 3c).

## Sinématiali

### Total population

The fruits flies persisted throughout the year the varied population according to the seasons. It was strongly decreased during dry season (November to January). At the beginning of the rainy season (February), the flies pullulated and the population showed two (2) peaks: one in April 2009 (2 788 flies) and a second in June 2009 with 7 568 flies (Figure 4a).

### Main species

The population of *B invadens* almost varied with the total population. It grew gradually from the beginning of the rainy season to reach a peak in June 2009 with 6 745 flies. On the other hand in dry season, this population dropped; 42 individuals were recorded in January 2009 (Figure 4b). As for *C. cosyra*, it appears in dry season (November) and pullulates as from December until reaching a peak of growth in March 2009 (1 453 flies), then a second peak in June 2009 (775 flies) (Figure 4c). The population of *C. bremii*, although low in dry season, high in rainy season with a peak of 393 flies in April 2009 (Figure 4c).

### Inventory emerged flies mango

Eight species of fruit flies have emerged mango. This was *B. invadens, B. cucurbitae, C.cosyra, C. punctata, C. rosa, D. punctatifrons, D. bivittatus* and *D. Langi*. The first two are the major species. They are represented in the proportions of 77.10% and 20.88% respectively for *B. invadens* and *C. cosyra*. Other species are a minority. Their attendance rate fluctuated between 0.01% and 1.71% (Figure 5).

## DISCUSSION

Several fruits flies species were recorded in the four sites of survey. The majority of them had been identified in other areas (Mwatawala*et al*., 2004; Vayssières*et al*., 2004, 2005) and in Côte-d'Ivoire (N'guetta, 1994, 1995; Ouattara, 1998; N'guetta et Hala, 1999; Barbet, 2000; Hala, 2001). The invasive fly *B. invadens* highly represented, was recently identified in Côte-d'Ivoire (N'dépo, 2006; Hala*et al*., 2006). Indeed, the introduction of these species in Côte-d'Ivoire could be due to exchanges of the fresh plants around the world (White et Elson-Harris, 1992). The species *B. invadens* was detected for the first time, in 2003, in Kenya (Lux *et al*., 2003), then in Tanzania (Mwatawala*et al*., 2004) and propagated in less two years in almost all the regions of Africa (Anonyme, 2006 ; De Meyer *et al*., 2007) and in

Côte-d'Ivoire (Hala*et al*., 2006 ; N'dépo, 2006 ; N'dépo*et al*., 2009). This rapid dissemination could be related to its character of good sailing ship and its large capacity of pullulation (N'dépo, 2006; N'dépo, 2010). The low level of *Ceratitis* populations, despite of their diversity, could be explained by an intense interspecific competition between this fly and the other indigenous species. Because *B. invadens* gradually adapted to the hosts plant to which are associated the majority with *Ceratitis*and even with the climatic conditions with the ecological niches inhabited by these last. In fact, the mango was a " host fruit " favourable and preferred to which the invasive specieswas pledged (Vayssières*et al.,* 2004, 2005; Mwatawala*et al.*, 2006a; Mwatawala*et al.*, 2006b; De Meyer *et al*., 2007; Ivan *et al*., 2008; N'dépo, 2010). This fruit is very favourable for the development of his offspring so well the fly has gradually adapted (Quilici, 2007; Ekesi*et al.*, 2009). With this quality the abiotic factors would be added (temperature, rainfall, relative humidity) and the diversity of the hosts plant. Also, it was announced the prevalence this species in mango, in Kenya and in Tanzania (Mwatawala*et al*., 2009a; Ekesi*et al.*, 2009). In station, just like in farming environment, *B. invadens* remains dominant. This could explain its status of "super candidate" compared to the other species, in particular *C. cosyra,* formerly majority in mango (Hala, 2001; Mwatawala*et al*., 2009b). This species is so impressive. From its strong invasion and dissemination, its great fecundity and fertility, its polyphagous character, this fly took the top on *C. cosyra* (Hala*et al*., 2006; N'dépo*et al*., 2009; Mwatawala*et al*., 2009b ;Ekesi*et al.*, 2009). Then, due to its strong pullulation, possessive character and aggressive behavior of the adults, *B. invadens* could have induced the displacement of the indigenous species towards other ecological niches (Duyck*et al*., 2004; Quilici*et al*., 2005; Ekesi*et al*., 2009; Mwatawala*et al*., 2009b). The high presence of *B. invadens* in Central and Northern Côte-d'Ivoire, could be mainly related to mango orchards. With that is added the availability of the hosts plant associated with the abiotic (temperature, rainfall, relative humidity) and biotic factors (predation, parasitism) which contributes to the distribution of fruit flies in the various ecological niches (Mwatawala*et al*., 2009a; Vayssières*et al*., 2009a). Also Sávio*et al*. (2008) were announced during their work to Brazil, the influence of pluviometry on the flies' dynamics in the mango orchards. They remark an increase of flies' population when pluviometry drops.

The follow-up of the fruit flies dynamic, in mango orchards, showed a high population of *B invadens* and *C. cosyra* in the zones. The fruits flies persisted throughout the year in the orchards. This presence dependent on spread out fructifications of the different cultivars in the orchards and the indigenous plants. Because according to Duyck*et al*. (2004) ;Mwatawala*etal*. (2006a,b) ; Ekesi*et al*. (2009) ; Vayssières*et al*. (2005) et N'dépo*et al*. (2009), the hosts plant just as the abiotic factors contribute to the fluctuation of the fruit flies. In Central and Northern Côte-d'Ivoire, during the four last years from 2005 to 2009, the principal identified mango pests were composed of *C. cosyra and B. invadens*. Although present throughout the year, the first species (*C. cosyra*) is abundant in dry season from February to April. This period coincided largely with the period of maturity of the early variety *Amelie*. This species had a population which is definitely higher than that of *B. invadens* at the beginning of the mango season. The second species, *B. invadens* highly major, appeared at the beginning of the rainy season (from April). Its period of pullulation coincided with the semi-late (*Kent*) and late (*Keitt, Palmer Brooks* etc.) varieties maturity and its population multiplied so quickly while supplanting the first species. This was also announced by Vayssières *et al*. (2005 et 2009a, b, c) in Benin. This significant pullulation could be explained by a great fecundity, a high fertility and a short cycle of development of *B. invadens* compared to *C. cosyra*(Ekesi*et al*., 2006, 2009). This could be the origin of the overpopulation of this species in the ecological niches and of the total domination on the other indigenous species, in particular *C. bremii, C. anone, C. rosa*and *C. cosyra* etc.; And of the displacement of the species towards other niches and hosts plant (Duyck*et al*., 2007; Vayssières *et al*. 2009a). In addition, the mango is a preferred host of *B. invadens*. Thus, it appears in a spectacular way for the maturity period of mangos (Mwatawala*etal*., 2006b; N'dépo, 2006; Quilici, 2007; Ekesi*et al*., 2009). This same report was observed in Kenya and in Tanzania where *B. invadens* was the principal pest of mangos (Mwatawala*etal*., 2006a,b; Ivan *et al*., 2008 ; De Meyer *et al*., 2009). It was the same in Central and Northern Benin where Vayssières*et al*. (2009b) observed a significant increase in the population of *B. invadens* at the beginning of the rain season in the zones of mangos production and also a positive correlation ($R = 0.74$; $P < 0.001$) between the rate of losses of mangos and the abundance of *B. invadens*. Thus, they follow the fructification period of the mango trees which is observed from mid-March to July in Central and Northern Côte-d'Ivoire.

## Conclusion

Sixteen species of fruits flies were identified in the mango orchards in Central and Northern of Côte-d'Ivoire. The invasive fly, *B. invadens* was more in the traps than others. Among the minor species, C*. cosyra* and *C. bremii*had a relatively significant level of populations. The invasive species was present along the whole year. It pullulates during the rainy season from March to August, with a peak of growth as from May. Apart from this period, the level of population of this species was low in dry season (September at February) in Central and Northern of Côte-d'Ivoire. The native fly *C. cosyra* prevails in dry season, grows as from February to reach

the season of the mangos (March at July), but it was supplanted by *B. invadens* as from April. As for *C. bremii,* it was presented in rainy season (April at July). Thus, a perfect knowledge of the periods of fluctuation of the fruit flies would contribute such to the installation of an effective and durable control of these pests.

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